Frequently Asked Questions Regarding The Cassini Mission

What is the probability of a launch accident?

- The expected probability of any type of launch (i.e., launch through spacecraft ejection from Earth orbit) accident for the Titan IV/Centaur is about 1 in 20; that is, on the average, 1 accident would be expected for every 20 Titan IV/ Centaur launches.
- However, only 1 in 500 Titan IV/Centaur launches are expected to result in an accident that releases small amounts of plutonium dioxide to the environment.
- In those accidents where there is a release, the radiation doses that are expected to result in the exposed population would be very low (less than one millirem over 50 years) and are not expected to result in any fatalities.

What is the probability of an accident between launch and leaving Earth orbit that might release plutonium?

While it is estimated that the probability of a Cassini launch failure is about 1 in 20, most failures would not result in a release of plutonium. Though more detailed assessments are underway, initial estimates are that about 1 in 25 Titan IV/Centaur failures could result in releases of small quantities of plutonium dioxide to the environment. It is possible that there could be small releases of plutonium dioxide particles from some RTG components, but if the components strike water there would be no release. None of the releases are expected to result in any cancer fatalities in the exposed population.

If the Cassini spacecraft had been: on the Titan IV that failed during launch on August 2, 1993, at Vandenberg; or on the Space Shuttle Challenger when it failed, what would have happened to the RTGs?

Neither of these launch accidents would have been expected to result in a release of fuel from the RTGs had the Cassini spacecraft been onboard. Years of extensive safety testing and analyses have demonstrated that RTGs are extremely rugged and resistant to a release of the plutonium dioxide fuel, even in severe accident environments.

Since 1965, when RTGs were built to ensure that they would not release radioactive material, there have been two accidents (1968 NIMBUS-B satellite launch and 1970 Apollo 13 lunar module reentry) where RTGs were on-board spacecraft. Neither of these accidents were caused by the RTGs. In both accidents, the RTGs responded to the accident conditions as their design and testing had predicted, and the plutonium was fully contained.

Bruce Gagnon of the Florida Coalition for Peace and Justice says Cassini could use the European Space Agency's Italian-made, high-efficiency solar cells instead of RTGs. What's your response?

- Mr. Gagnon is incorrect.
- NASA’s Jet Propulsion Laboratory conducted an in-depth analysis of the available electrical power systems, including many different solar, battery, and long life fuel cell power sources and hybrid systems to identify the most appropriate power source for the Cassini mission.
- A JPL study showed that a Cassini spacecraft equipped with the highest efficiency solar cells available (including the new high-efficiency cells under development by ESA) would make the spacecraft too massive for launching to Saturn. The resulting solar arrays would need an area greater than 500 square meters (5,380 square feet) that is over the size of two tennis courts. The dimensions of each array (the spacecraft would require two), would need to be about 9 meters (30 feet) wide and 32 meters (105 feet) long.
- The researchers who developed the ESA solar cells evaluated the JPL solar study and concluded that “LILT solar cells (including those developed by ESA) are not a viable power source alternative for the presently defined Cassini mission of NASA.”

Why can't Cassini use solar-power?

It was determined that 12 science instruments are needed to investigate Saturn, its rings, moons and magnetosphere over a 4-year period in order to meet the Cassini science objectives that were set by the NASA Solar System Exploration Committee. This results in a spacecraft and instrument power demand of between 600-700 watts of power in outer space. This power must be produced reliably for over 12 years at a distance that is 9 times further from the sun than the earth, and still be small and light enough to be launched from the earth and reach Saturn.

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How can the probability of an Earth swingby reentry accident be so low?

The Cassini spacecraft has design requirements to ensure that the chance of an inadvertent reentry during Earth swingby are less that 1 in 1 million. To attain that goal JPL has conducted an in-depth analysis, which incorporated human error and historical JPL spacecraft data, to determine the probability of an inadvertent reentry. This analysis determined that the probability of an inadvertent Earth reentry is less than one in one million. The result is driven by two factors:

- For most of the trajectory the spacecraft will be nowhere near the Earth.
- A trajectory biasing strategy, coupled with redundant spacecraft system design, built-in fault detection and correction systems, and the ability to send commands to the spacecraft, lead to the exceedingly small probability of Earth impact.

The Cassini mission is being designed to ensure than an inadvertent swingby accident does not occur. Mission rules state that the chance of such an accident occurring must be less than one in one million. JPL has conducted an in-depth analysis, which incorporated human error and historical JPL spacecraft data, to determine the probability of an inadvertent reentry. This analysis determined that the probability of an inadvertent Earth reentry is less than one in one million. This result may be surprising to some people (at first) since it is difficult to prove that failures of any system, particularly spacecraft, can be that small. The result is driven by two factors.

First, for most of the Cassini trajectory it is very hard to hit the Earth. In fact, until about 50 days before Earth swingby, the probability of hitting the Earth is much less than 1 in a million regardless of the spacecraft failure (this is because of the vastness of space, the smallness of the Earth as a target, and the randomness of a spacecraft failure or micrometeoroid hit leading to a velocity change).

Second, JPL has "biased" the trajectory for Earth swingby. This scheme further limits the time and events that could cause inadvertent reentry by eliminating all failures except those that give the spacecraft the proper velocity magnitude and direction to impact the Earth. The spacecraft is biased 5,000 kilometers (3,106 miles) or more away from the swingby altitude (not less than 500 km) for all but 10 days prior to the swingby. The navigation accuracy of NASA spacecraft is better than 20 km. The biasing strategy effects, coupled with redundant spacecraft system design, built-in fault detection and correction systems, and controlled operation (via sending commands to the spacecraft), particularly during the limited time when failures could cause impact, lead to the exceedingly small probability of Earth impact.

In addition, these analyses are constantly being reviewed and refined, and revisions made in spacecraft design to ensure that the design requirement will not be exceeded.

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